Reasoning on Graphs: Faithful and Interpretable Large Language Model Reasoning

Year: 2023 | Citations: 367 | Authors: Linhao Luo, Yuan-Fang Li, Gholamreza Haffari

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Abstract

Large language models (LLMs) have demonstrated impressive reasoning abilities in complex tasks. However, they lack up-to-date knowledge and experience hallucinations during reasoning, which can lead to incorrect reasoning processes and diminish their performance and trustworthiness. Knowledge graphs (KGs), which capture vast amounts of facts in a structured format, offer a reliable source of knowledge for reasoning. Nevertheless, existing KG-based LLM reasoning methods only treat KGs as factual knowledge bases and overlook the importance of their structural information for reasoning. In this paper, we propose a novel method called reasoning on graphs (RoG) that synergizes LLMs with KGs to enable faithful and interpretable reasoning. Specifically, we present a planning-retrieval-reasoning framework, where RoG first generates relation paths grounded by KGs as faithful plans. These plans are then used to retrieve valid reasoning paths from the KGs for LLMs to conduct faithful reasoning. Furthermore, RoG not only distills knowledge from KGs to improve the reasoning ability of LLMs through training but also allows seamless integration with any arbitrary LLMs during inference. Extensive experiments on two benchmark KGQA datasets demonstrate that RoG achieves state-of-the-art performance on KG reasoning tasks and generates faithful and interpretable reasoning results.